# Zebra Mussels
**(*Dreissena polymorpha*)**

The zebra mussel is a freshwater nuisance species native to the Caspian region of western Russia. It was first reported in the US in 1988, most likely brought here in the ballast water of foreign cargo ships.

**Range:** 22 states and two Canadian Provinces (see map).

**Characteristics:**

1. Shell D-shaped, dark and light-colored stripes, sometimes confused with *Corbicula* (Asiatic clam)
2. Often found in colonies/clusters (druses)
3. Attach to wide variety of substrates using byssal threads
4. Dioecious: 40,000 eggs can be laid per reproductive cycle/ one million in a spawning season.
5. Live 3-9 years, up to 2 inches in length, usually closer to one inch.

**Habitat Requirements:**

1. Temperature Range: > 8 $^{o}$C and for reproduction is 10 to 12 $^{o}$C
2. Salinity: Up to 4 ppt for N.A. populations; up to 10 ppt in Europe
3. Calcium: 20 to 50 mg/l
4. Ph: 7 to <9
5. Maximum attachment velocity: Up to 1 m/sec, prefers < .27 meters per second; can be found in higher velocity areas of up to 2 m/sec (if irregular surfaces or small eddy areas)

**Range Expansion:** The first ten years after their initial introduction zebra mussels rapidly spread throughout the Great Lakes and Mississippi River drainage through tremendous reproductive capability and passive downstream drift of veligers (larvae). Zebra mussels move between water bodies by attaching to boat hulls, trailers, or aquatic weeds that are caught on a trailer or propeller, or by contaminating live wells, bait buckets, and bilges. Depending on their age, they can survive <u>outside</u> of the water for at least five days.

**Columbia River Basin Threat?**

Zebra mussels continue to expand their range and threaten the CRB. In the past two years, several events have raised concerns about the potential for an invasion:

1. **Summer 2003:** Zebra mussel veligers were discovered in the middle Missouri River in Northeast Nebraska.
2. **May 2004:** A boat from Tennessee was intercepted just east of Spokane with live zebra mussels.
3. **June 2004:** An infested houseboat from Kentucky was intercepted at Lake Mead.
4. **March 2005:** A zebra mussel infested boat was intercepted in the Gallatin Valley, Montana.
5. **October 2005**: A jar of freshly dead zebra mussels was left on the doorstep of the Charles M. Russell Wildlife Center near Fort Peck Reservoir (Jordon, Montana).

The zebra mussel is one of the most economically damaging aquatic organisms to invade the US. Its destructive power lies in its sheer numbers (up to 750,000 individuals per square meter) and its ability to attach itself to solid objects – water intake pipes, propellers, boat hulls, dock pilings, submerged rocks and even other aquatic animals. Colonies of zebra mussels clog filters, pipes, pumps, and power plant cooling systems. The environmental impact of zebra mussels upon lakes and rivers can be profound.

- **Threats to salmon:** If introduced into the Columbia River Basin, zebra mussels could threaten the health and survival of native salmon and steelhead stocks. Zebra mussels would likely attach to fish ladders, fish diversion screens, and other pipes and conduits, likely resulting in expensive maintenance and physical damage to adult and juvenile salmon (possibly affecting survival).

- **Threats to the FCRPS:** Colonization of the Columbia River Basin (CRB) by zebra mussels could affect submerged components and conduits of the Federal Columbia River Power System (FCRPS) including trash racks, raw water distribution systems (headers), turbine bearing cooling systems, diffuser plates, service and fire-water systems.

**Prevention: Agency Response**

Since 1999, the BPA (Power Generation/Federal Hydro System Group) has funded the Pacific States Marine Fisheries Commission (and Portland State University) to undertake an aquatic nuisance species program with emphasis on zebra mussel prevention, education and monitoring. The CRB states of Oregon, Washington, Montana have zebra mussel prevention and monitoring programs. The USFWS is active in zebra mussel prevention through the 100$^{th}$ Meridian Initiative -- a cooperative effort between state, provincial, and federal agencies to prevent the spread of zebra mussels.

**Rapid Response**

In the past year, agency efforts have concentrated on developing a zebra mussel rapid response plan for the Columbia River Basin. This rapid response plan will include all of the strategies, activities and decision making criteria necessary in event an introduction occurs.

**Links**

**USGS Zebra Mussel Page:** http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/
**100$^{th}$ Meridian Initiative**: www.100thmeridian.org.
**USACE ZM Information System**: http://el.erdc.usace.army.mil/zebra/zmis/Zebra Mussel Monitoring
**Portland State:** http://www.clr.pdx.edu/projects/volunteer_monitoring/zebramussel/index.html
**Pacific State Marine Fisheries Commission:** http://www.psmfc.org/ANS

**Contact Information**


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# Permitting Questions

**For chemicals used in zebra mussel control**

Of all the chemical zebra mussel eradication methods tested thus far, chlorination/NaOCl has gained the greatest acceptance. For example, Ontario Power Generation (OPG) uses injected NaOCl (0.5-0.7 ppm) for three weeks when the water temperature is above 20°C (Niagara River). The OPG must meet water quality standards through a Certificate of Approval process (similar to the U.S.'s NPDES permit). Outlet water must be below 10 ppb of NaOCl.

In 1993, an automated chlorine injection system was installed by the Nashville District Corps at two district hydropower plants in the Cumberland River Basin. Prior to making the decision to install chlorine injection systems, NDC and the Tennessee Valley Authority prepared an Environmental Assessment (NEPA). The system has not been used as zebra mussel populations have not reached nuisance levels.

Most of the uncertainties for zebra mussel mitigation relate to the use and permitting of sodium hypochlorite. We have two scenarios that need to be explored regarding permitting:

- An established infestation in which a quick, emergency, and likely very toxic response is needed for eradication (**BUT**, total eradication of a zebra mussels population is almost always not feasible); and

- Permit requirements for experimental activities (e.g., prototyping injection systems for Corps facilities) in preparation for a potential future infestation.

**QUESTIONS**

1. **NPDES,** chlorine/sodium hypochlorite**:** What is the effluent limit allowable under CWA (Section 402)? Is there a pre-approval process that can be pursued? Permits needed for both OR and WA?

2. **ESA Section 7** (USFWS, NOAA): What is needed for an emergency consultation? How long is the process?

3. **FIFRA** – Both chlorine and sodium hypochlorite are designated as pesticides when targeted to kill pests. Section 18 emergency exemption, how does it apply.

4. **NEPA** – EIS for control activities….need to start scoping soon? Ability to use emergency clause?

5. **Physical Removal:** dewatering, sand blasting, state HPAs for operating heavy equipment within the channel, would run off require permits? ESA? CWA?

6. **Cost/benefit:** For all of the above, how to address potential water quality/ecological impacts of widespread zm infestation if eradication is not attempted vs. impacts of eradication activities?

7. **Permitting**: Is there a state/federal agency contact list for ESA, CWA permitting questions?